On-site Investigation
Vehicle vs Vehicle vs Vehicle–Rear End Chain Collision
Dynamic Science, Inc. / Case Number: DS99047
1995 Geo Prizm 4-door
Colorado
September 1999

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient Catalog No.
DS99047		

4. Title and Subtitle	5. Report Date
In-Depth Accident Investigation	January, 2001
	6. Performing Organization Report No.

7. Author(s)	8. Performing Organization Report No.
Dynamic Science, Inc.	

9. Performing Organization name and Address	10. Work Unit No. (TRAIS)
Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401	11. Contract or Grant no. DTNH22-94-D-27058

12. Sponsoring Agency Name and Address	13. Type of report and period Covered [Report Month, Year]
U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590	14. Sponsoring Agency Code

15. Supplemental Notes

16. Abstract

Please note that this crash was originally listed as a confirmed air bag related fatality; however, subsequent analytical modeling information presented by NHTSA engineers reviewing this case indicated that the fatal laceration of the right ventricle appears to be along the seat belt line, and was not associated with the air bag and, as a result, this crash was dropped from the "confirmed" status.

This crash occurred in the middle westbound lanes at a controlled four leg intersection of an urban street in September 1999 at 1850 hours. The intersection is controlled by standard tri-colored signals that were functioning properly at the time of the crash. The posted speed limit for east-west traffic is 64 km/h (40 mph). Several of the emergency rescue personnel and drivers of the other vehicles involved in the crash indicated that the sun glare was severe for westbound traffic. The sun glare may have been a contributing factor in the collision as well as a 0.223 blood alcohol count (BAC) for the driver of the case vehicle.

The case vehicle, a 1995 Geo Prizm 4-door driven by a restrained 64-year-old female (155 cm-61 in./50 kg-110 lb), was traveling westbound in the middle through lane at a police estimated 64 km/h (40 mph) and approaching the intersection. The other vehicle, a 1995 Mitsubishi Galant LS 4-door driven by a 20-year-old female, was the second vehicle stopped at the intersection for the red signal directly in front of the case vehicle. The third vehicle, a 1997 Nissan Pathfinder driven by a 30-year-old male, was stopped at the intersection directly in front of the Mitsubishi.

The case vehicle was approaching the intersection and due to the sun glare does not appear to have seen the red signal or the stopped vehicles directly in front of her. Both drivers of the other vehicles through their rear view mirrors saw the case vehicle approaching them at what they thought was a high rate of speed. The driver of the case vehicle did not brake and the front of the case vehicle (12FDEW2) struck the back of the Mitsubishi (06BDEW3). The case vehicle sustained a total delta V of 28.2 km/h (17.6 mph), a longitudinal delta V of -28.2 km/h (-17.6 mph), and a lateral delta V of 0. Both frontal air bags in the case vehicle deployed.

Fire department rescue personnel were notified at 1854 hours and arrived at the scene at 1857 hours. They treated injured parties at the scene and transported the driver of the case vehicle, the driver of the Mitsubishi, and three of the occupants of the Nissan to a local hospital. They arrived at the hospital at 1908 hours.

The driver of the case vehicle was transported to a local hospital. She was treated but despite resuscitative measures, expired at 1927 hours of the same day. An invasive autopsy was performed and the coroner noted that the driver sustained blunt impact to the trunk, head, neck and extremities. She sustained a 1.3 cm (0.5 in.) transmural laceration of the right ventricle of the heart (AIS 5) near the apex, which led to a cardiac tamponade (anamnestic) due to 100 cc of blood in the pericardium. Fractures of the 4th and 5th ribs (unknown aspect) with residual bilateral hemothoraces (AIS 3) consisting of 200 cc of liquid blood in each side. It should be noted that the coroner did not know whether the rib fractures where as a result of the crash forces or medical therapy. The driver also sustained abrasions (AIS 1) over the tip of the nose measuring 1.9 cm (0.75 in.) and an abrasion (AIS 1) over the left side of the nose measuring 0.6 cm (0.25 in.). There was an abrasion (AIS 1) over the anterior chin that extended onto the upper anterior neck and measured 3.8 cm (1.5 in.). There was an abraded contusion (AIS 1) over the right anterior and lateral neck measuring 5.1 cm (2 in.). There was an irregularly contoured contusion (AIS 1) over the right upper chest measuring 10.2 cm (4 in.) and a contusion (AIS 1) over the medial aspect of the left arm measuring 3.2 cm (4 in.). The abrasions and contusions are attributed to contact with the driver's air bag. The driver also sustained contusions (AIS 1) over the inferior right knee and anterior right leg measuring 1.9 cm (0.75 in) as a result of contacting the lower left instrument panel area. The coroner indicated no fractures of the calvarium, basilar skull, or evidence of injury to the brain or the cervical spine. The coroner also noted acute ethanol intoxication with blood ethanol level of 223 mg/dl (0.223 BAC). It should be noted that the coroner indicated pre-existing medical conditions for the driver of the case vehicle. She had hypertensive arteriosclerotic cardiovascular disease with focal severe coronary artery atherosclerosis, severe atherosclerosis of the aorta, benign nephrosclerosis, clinical history of hypertension, pulmonary emphysema with a history of smoking, fatty change of the liver. She had a left mastectomy, with a history of breast cancer without evidence of residual malignancy. A total abdominal hysterectomy/bilateral salpingo-oophorectomy and appendectomy.

17. Key Words	18. Distribution Statement
Air bag, deployment, injury, fatality, driver	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price

Dynamic Science, Inc.
Accident Investigation
Case Number: DS99047

TABLE OF CONTENTS

BACKGROUND: **Please note that this crash was originally listed as a confirmed air bag related fatality: however, subsequent analytical modeling information presented by NHTSA engineers reviewing this case indicated that the fatal laceration of the right ventricle appears to be along the seat belt line, and was not associated with the air bag and, as a result, this crash was dropped from the "confirmed" status.**

Description: This case was initiated in response to a report of fatal injuries sustained by the driver of the case vehicle as a result of the deployment and interaction with the driver's air bag. This case was conducted as an on-scene investigation. Present at the inspection were members of the local police department that were investigating the crash. The NHTSA notified DSI on September 21, 1999.

Investigation Type: On-scene

Crash Location: Colorado
Crash Date: September, 1999
Notification Date: September 21, 1999
Field Work Completed: September 23, 1999

SUMMARY:

This crash occurred in the middle westbound lanes at a controlled four leg intersection of an urban street in September 1999 at 1850 hours. The east-west roadway is a divided , seven lane, straight, asphalt roadway. The westbound travel lanes consist of three through lanes, and a left turn lane. There is a positive 0.4 % grade for westbound travel lanes. The eastbound travel lanes consist of three through lanes, and a left turn lane. East and west traffic is separated by a raised concrete center median. The intersection is controlled by standard tri-colored signals that were functioning properly at the time of the crash. The weather was clear and dry and the roadway was dry and free of defects. The posted speed limit for east-west traffic is 64 km/h (40 mph). Several of the emergency rescue personnel and drivers of the other vehicles involved in the crash indicated that the sun glare was severe for westbound traffic. The sun glare may have been a contributing factor in the collision as well as a 0.223 blood alcohol count (BAC) for the driver of the case vehicle.

Figure 1. Direction of travel towards the impact area–westbound.

The case vehicle, a 1995 Geo Prizm 4-door driven by a restrained 64-year-old female (155 cm-61 in./50 kg-110 lbs), was traveling westbound in the middle through lane at a police estimated 64 km/h (40 mph) and approaching the intersection.

Figure 2. Exterior damage to the case vehicle at the scene.

The other vehicle, a 1995 Mitsubishi Galant LS 4-door driven by a 20-year-old female, was the second vehicle stopped at the intersection for the red signal directly in front of the case vehicle.

The third vehicle, a 1997 Nissan Pathfinder driven by a 30-year-old male, was stopped at the intersection directly in front of the Mitsubishi.

Figure 3. Back end damage to other vehicle at scene.

The case vehicle was approaching the intersection and due to the sun glare does not appear to have seen the red signal or the stopped vehicles directly in front of her. Both drivers of the other vehicles through their rear view mirrors saw the case vehicle approaching them at what they thought was a high rate of speed. The driver of the case vehicle did not brake and the front of the case vehicle (12FDEW2) struck the back of the Mitsubishi (06BDEW3). The case vehicle sustained a total delta V[1] of 28.2 km/h (17.6 mph), a longitudinal delta V of -28.2 km/h (-17.6 mph), and a lateral delta V of 0. Both frontal air bags in the case vehicle deployed. The Mitsubishi sustained a total delta V of 24.2 km/h (15.0 mph), a longitudinal delta V of 24.2 km/h (15.0 mph), and a lateral delta V of 0. The results fit the collision model and appear normal for both vehicles.

The crash between the case vehicle and the Mitsubishi pushed the Mitsubishi forward. At the same time, the driver of the Nissan accelerated rapidly in an effort to evade being rear ended by the Mitsubishi. The front of the Mitsubishi (12FDEW1) struck the back of the Nissan. The Mitsubishi sustained a total delta V[2] of 11.1 km/h (6.9 mph), a longitudinal delta V of -11.1 km/h (-6.9 mph), and a lateral delta V of 0. The frontal air bags in the Mitsubishi did not deploy. The Nissan sustained a total delta V of 6.9 km/h (4.3 mph), a longitudinal delta V of 6.9 km/h (4.3 mph), and a lateral delta V of 0. The results fit the collision model and appear normal for the Mitsubishi, but the results are borderline for the Nissan given that it was not inspected.

After the collision, the case vehicle moved forward in a north-westerly direction, rotated clockwise, and came to final rest at north-west corner of the intersection approximately 20.4 m (67 ft) from the impact area, heading north. The Mitsubishi continued moving forward and came

---

[1] Calculated using WinSmash 1.2.1 damage algorithm. Stiffness coefficients (d_1 and d_0) were calculated using NHTSA sponsored crash test results. For the case vehicle a clone vehicle-1994 Toyota Corolla-was used. For the Mitsubishi, NASS Coding Manual size and stiffness values were used.

[2] Calculated using WinSmash 1.2.1 missing vehicle algorithm.

to final rest in the intersection approximately 9.4 m (31 ft) from the area of impact with the Nissan, in the same lane heading west. The Nissan had accelerated forward prior to being rear ended and after the crash came to a controlled stop in the middle of the intersection in the far right lane heading west.

The case vehicle sustained major damage to its front end and was towed from the scene due to damage. The Mitsubishi sustained major damage to its back end and moderate damage to its front end. It was towed from the scene due to damage. The police report indicates that the Nissan sustained moderate damage to its back end and was driven from the scene by the driver.

Fire department rescue personnel were notified at 1854 hours and arrived at the scene at 1857 hours. They treated injured parties at the scene and transported the driver of the case vehicle, the driver of the Mitsubishi, and three of the occupants of the Nissan to a local hospital. They arrived at the hospital at 1908 hours.

The driver of the Mitsubishi complained of pain to her back and neck. She was transported to a local hospital where she was treated and released. The driver of the Nissan drove himself to the hospital and received treatment and medication for unknown neck and back injuries. The front right, 2nd seat left, 2nd seat right occupants in the Nissan were transported by ground ambulance from the scene to a local hospital. The driver of the Nissan indicated to the police that they were all treated and given medication for unknown neck and back injuries.

After the crash, the driver of the Nissan approached the case vehicle. He noted the driver of the case vehicle was unconscious, and that she appeared to be trying to catch her breath, but it appeared she could not breath. She did not appear to be in convulsions but was shaking. The driver of the Nissan tried to find a pulse, but could not. The driver of the Nissan set the transmission to park on the case vehicle, and then assisted fire rescue personnel when they arrived on scene.

The driver of the case vehicle was transported to a local hospital. She was treated but despite resuscitative measures, expired at 1927 hours of the same day. An invasive autopsy was performed and the coroner noted that the driver sustained blunt impact to the trunk, head, neck and extremities. She sustained a 1.3 cm (0.5 in.) transmural laceration of the right ventricle of the heart (AIS 5) near the apex, which led to a cardiac tamponade[3] (anamnestic) due to 100 cc of blood in the pericardium. Fractures of the 4th and 5th ribs (unknown aspect) with residual bilateral hemothoraces (AIS 3) consisting of 200 cc of liquid blood in each side. It should be noted that the coroner did not know whether the rib fractures where as a result of the crash forces or medical therapy. The driver also sustained abrasions (AIS 1) over the tip of the nose measuring 1.9 cm (0.75 in.) and an abrasion (AIS 1) over the left side of the nose measuring 0.6 cm (0.25 in.). There was an abrasion (AIS 1) over the anterior chin that extended onto the upper anterior neck and measured 3.8 cm (1.5 in.). There was an abraded contusion (AIS 1) over the right anterior and lateral neck measuring 5.1 cm (2 in.). There was an irregularly contoured contusion (AIS 1) over

[3] Interference with the venous return of blood to the heart due to an extensive accumulation of blood in the pericardium (pericardial effusion). Tamponade may occur as a complication of dissecting thoracic aneurysm, pericarditis, renal failure, acute myocardial infarction, hypothyroidism, chest trauma or a malignancy.

the right upper chest measuring 10.2 cm (4 in.) and a contusion (AIS 1) over the medial aspect of the left arm measuring 3.2 cm (4 in.). The abrasions and contusions are attributed to contact with the driver's air bag. The driver also sustained contusions (AIS 1) over the inferior right knee and anterior right leg measuring 1.9 cm (0.75 in) as a result of contacting the lower left instrument panel area. The coroner indicated no fractures of the calvarium, basilar skull, or evidence of injury to the brain or the cervical spine. The coroner also noted acute ethanol intoxication with blood ethanol level of 223 mg/dl (0.223 BAC).

It should be noted that the coroner indicated pre-existing medical conditions for the driver of the case vehicle. She had hypertensive arteriosclerotic cardiovascular disease with focal severe coronary artery atherosclerosis, severe atherosclerosis of the aorta, benign nephrosclerosis, clinical history of hypertension, pulmonary emphysema with a history of smoking, fatty change of the liver. She had a left mastectomy, with a history of breast cancer without evidence of residual malignancy. A total abdominal hysterectomy/bilateral salpingo-oophorectomy and appendectomy.

The coroner attributed her death to "cardiac tamponade (anamnestic) due to a laceration of the right ventricle of the heart arising as the result of blunt impact to the trunk."

Figure 4. Case vehicle's driver's air bag and lipstick contact.

The case vehicle was equipped with a driver's side supplement restraint system that deployed as a result of the case vehicle's frontal impact with the back of the Mitsubishi. The driver's air bag deployed from the module assembly that was contained within the four-spoke steering wheel. The module cover flaps were of typical Chevrolet design with a large upper flap and smaller lower flap. These flaps opened in an H-configuration at the designated tear points. There was no damage or evidence of driver contact to the module covers. The driver's air bag measured 57 cm (22.4 in.) in diameter. There was a 9 cm (3.5 in.) long lipstick contact to the left upper quadrant of the air bag and a 8 cm (3.1 in.) long makeup transfer in the same area. The air bag itself was not damaged. The air bag had nine vertical folds, was not tethered, and had two rear vent ports. The post deflated maximum air bag excursion was measured at 44 cm (17.3 in.), and the distance from the maximum air bag excursion to the seat back was 37 cm (14.6 in.).

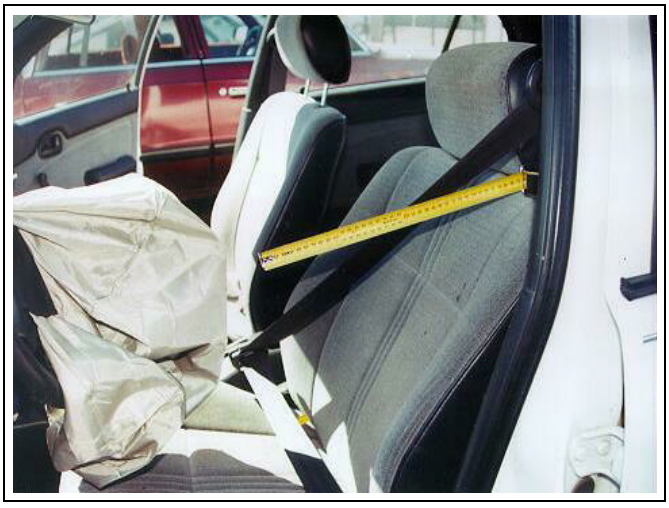

Figure 5. Case vehicle, distance from max air bag excursion to seat back.

The driver of the case vehicle was seated in a cloth covered bucket type seat. The seat

track was adjusted to the middle seat track position, and the seat back was slightly reclined. She was in close proximity to the steering wheel and restrained by the lap and shoulder belts. The sun glare played a role in the crash as did the driver's alcohol level. It appears that the driver did not see the red signal or the stopped vehicles directly in front of her. There was no pre-impact braking. As the case vehicle struck the back to the Mitsubishi, the driver of the case vehicle went forward. Her chest contacted the deploying driver's air bag as did her face as noted by the lipstick transfer in the upper left quadrant of the driver's air bag. The air bag also contacted her chin and the anterior part of her neck. The fatal injury (the laceration of the right ventricle of the heart near the apex, which led to a cardiac tamponade--anamnestic) appear to be along the seat belt line as a result of loading the 3-point seat belt. Engineers at NHTSA reviewing this report have indicated that analytical modeling of thoracic trauma in frontal impacts have yielded loading patterns on the chest that indicate that 3-point seat belted occupants receive concentrated loading from the seat belt. The laceration of the right ventricle of the heart are being attributed to the loading of seat belt given the location of the injury with respect to the seat belt, the driver's medical condition, her age, and the crash conditions. It is not known wether the fractured ribs where as a result of the crash forces or medical therapy. The driver continued moving forward and struck the lower instrument panel with both of her legs. There was no evidence that the driver contacted the module covers and the steering column was not displaced, there was no measurable displacement of the shear capsules.

Scene Diagram

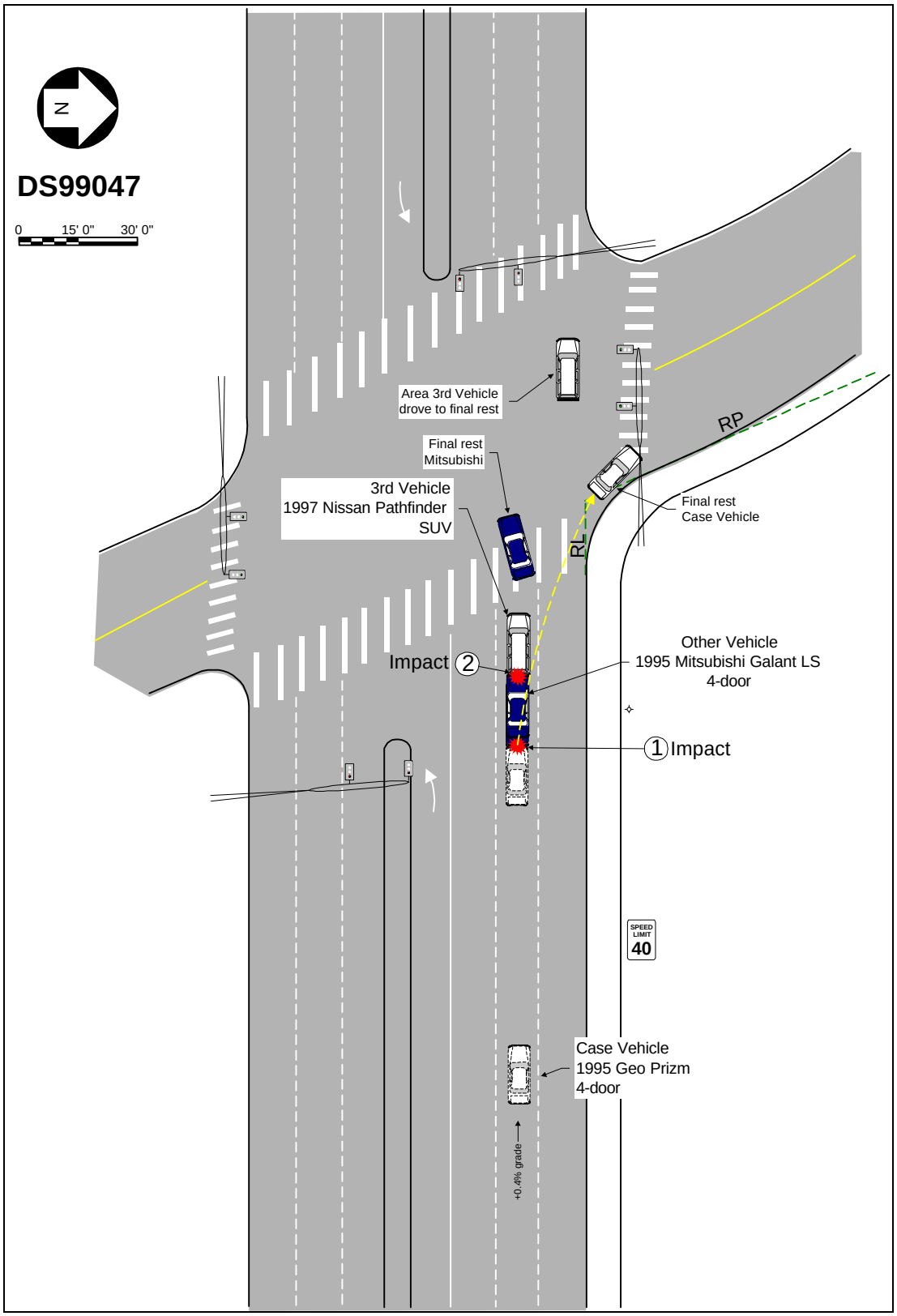

Figure 6. Scene diagram

COLLISION MEASUREMENTS

Case Number DS99047

Reference Point: Prolongation of east edge of north-south road

Reference Line: Prolongation of north edge of east-west road

DATA POINT	Direction and Distance from R/P	Direction and Distance from R/L
Impact 1- Case vehicle vs Mitsubishi	19.1 m (62 ft 7 in.) E	5 m (16 ft 6 in.) S
Final Rest for case vehicle		
RF-Tire	1.7 m (5 ft 7 in.) E	5.1 m (16 ft 9 in.) S
LF-Tire	1.8 m (6.0 ft) E	6.8 m (22 ft. 3 in.) S
RR-Tire	5.1 m (16 ft 9 in.) E	4.2 m (13 ft 11 in.) S
LR-Tire	4.9 m (16 ft 1 in.) E	6.1 m (19 ft 11 in.) S
Final Rest for Mitsubishi		
RF-Tire	0.9 m (2 ft 10 in.) W	3.7 m (12 ft 3 in.) N
LF-Tire	2.6 m (8 ft. 6 in.) W	2.7 m (8 ft 9 in) N
RR-Tire	0.4 m (1 ft 2 in.) E	1.9 m (6 ft 2 in.) N
LR-Tire	1.3 m (4 ft 4 in.) W	0.6 m (1 ft 10 in.) N

DETAILED INFORMATION

Vehicles

Case Vehicle

Description:	1995 Geo Prizm 4-door	
VIN:	1Y1SK5265SZXXXXXX	
Odometer:	68,149 km (42,347 miles)	
Engine:	V4	
Reported Defects:	None reported	
Cargo:	None	
Damage Description:	Major damage to front bumper, hood and grille area. Both of the front fenders were deformed.	
CDC:	Impact 1 (case vehicle vs. Mitsubishi) - 12FDEW2	
Delta V:	Total	28.2 km/h (17.6 mph)
	Longitudinal	-28.2 km/h (-17.6 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	27,970 joules (20,649 ft-lbs)

Figure 7. Exterior damage.

Other Vehicle Mitsubishi

Description:	1995 Mitsubishi Galant LS 4-door	
VIN:	4A3AJ56G6SEXXXXXX	
Odometer:	144,309 km (89,672 miles)	
Engine:	2.4L SOHC MPI	
Reported Defects:	None noted	
Cargo:	None	
Damage Description:	Major damage to its rear bumper, rear hood, and both rear fenders. Moderate damage to the front bumper, hood, and grille area. Both front fenders were deformed.	
CDC:	Impact 1 (vs. case vehicle) - 06BDEW3 Impact 2 (vs. 3rd vehicle) - 12FDEW1	
Delta V (Impact 1 vs. case vehicle):	Total	24.2 km/h (15.0 mph)
	Longitudinal	24.2 km/h (15.0 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	36,011 joules (26,576 ft-lbs)
Delta V (Impact 2 vs. 3rd vehicle Nissan):	Total	11.1 km/h (6.9 mph)
	Longitudinal	-11.1 km/h (-6.9 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	3,374 joules (2,487 ft-lbs)

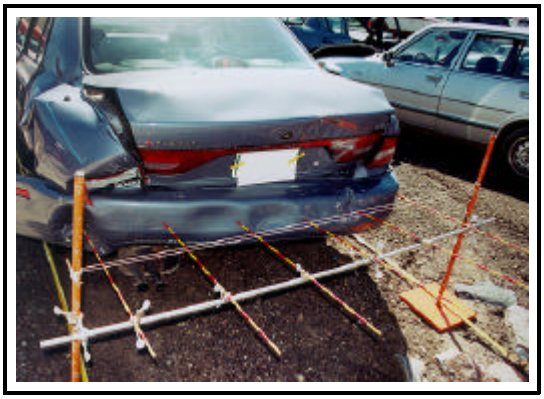

Figure 8. Exterior back damage.

3rd Vehicle Nissan

Description:	1997 Nissan Pathfinder	
VIN:	JN8AR05Y5VWXXXXXX	
Odometer:	Unknown	
Engine:	2.4L	
Reported Defects:	None noted on police report	
Cargo:	Unknown	
Damage Description:	Police report indicates moderate damage to its back end.	
CDC:	Impact 2 - Unknown	
Delta V:	Total	6.9 km/h (4.3 mph)
	Longitudinal	6.9 km/h (4.3 mph)
	Latitudinal	0 km/h (0 mph)
	Energy	6,731 joules (4,958 ft-lbs)

Occupants

Case Vehicle	Occupant 1
Age/Sex:	64/Female
Seated Position:	Front left
Seat Type:	Cloth covered bucket seat
Height:	155 cm (61 in.)
Weight:	50 kg (110 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	Focal severe coronary artery atherosclerosis. Severe atherosclerosis of aorta. Benign nephrosclerosis. Clinical history of hypertension. Pulmonary emphysema with history of smoking. Fatty change of the liver. Left mastectomy with history of breast cancer, without evidence of residual malignancy. Total abdominal hysterectomy/bilateral salpingo-oophorectomy and appendectomy.
Alcohol/Drug Involvement:	Acute ethanol intoxication with blood ethanol level 223 mg/dl. Negative for drugs of abuse. Caffeine and hyoscyamine present.
Driving Experience:	Unknown
Body Posture:	Assumed normal, upright.
Hand Position:	Unknown, assumed both on steering wheel.
Foot Position:	Right foot on accelerator pedal, left foot on floorboard
Restraint Usage:	Lap and shoulder belts used
Air bag:	Steering wheel hub driver’s air bag present and deployed as a result of impact

Other Vehicle Mitsubishi	Occupant 1
Age/Sex:	20/Female
Seated Position:	Front left
Seat Type:	Cloth covered bucket seat
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Assumed normal, upright
Hand Position:	Unknown
Foot Position:	Assumed right foot on brake pedal and left foot on floor board
Restraint Usage:	Lap and shoulder belts used–per police report
Air bag:	Vehicle equipped with a driver's air bag, but it did not deploy

3rd Vehicle Nissan	Occupant 1	Occupant 2
Age/Sex:	30/Male	30/Male
Seated Position:	Front left	Right front
Seat Type:	Unknown	Unknown
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	Unknown	Unknown
Body Posture:	Assumed normal, upright	Assumed normal, upright
Hand Position:	Unknown	Unknown
Foot Position:	Assumed right foot on accelerator pedal and left foot on floor board	Unknown
Restraint Usage:	Lap and shoulder belts used–per police report	Lap and shoulder belts used-per police report
Air bag:	Air bag available, but did not deploy	Air bag available, but did not deploy

3rd Vehicle Nissan (cont...)	Occupant 3	Occupant 4
Age/Sex:	22/Female	21/Male
Seated Position:	2nd seat left	2nd seat right
Seat Type:	Unknown	Unknown
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	Unknown	Unknown
Body Posture:	Assumed normal, upright	Assumed normal, upright
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belts used–per police report	Lap and shoulder used--per police report
Air bag:	NA	NA

Injuries and Injury Mechanisms

Case Vehicle

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	1.3 cm (0.5 in.) transmural laceration of the right ventricle of the heart near the apex, including cardiac tamponade (anamnestic). Mild degree of surrounding intramyocardial hemorrhage[4].	441012.5, 4	861.03	Seat belt
	Fractures of 4th and 5th ribs–unknown to coroner if fractures occurred as a result of crash or medical therapy. Residual bilateral hemothoraces consisting of 200 cc of liquid blood in each side.	450222.3, 9	807.02[5] 860.2[6]	Unknown if seat belt related or from resuscitative efforts
	Abrasion over tip of nose measuring 1.9 cm (.75 in.). Abrasion over left side of nose measuring 0.6 cm (.25 in.).	290202.1, 4	910.0	Air bag
	Abrasion over anterior chin and extends onto upper anterior neck measuring 3.8 cm (1.5 in).	290202.1, 8 390202.1, 0	910.0 910.0	Air bag
	Abraded contusion over right anterior and lateral neck measuring 5.1 cm (2 in.)	390402.1, 0	910.0	Air bag

[4] The escape of blood from the vessels, bleeding from the middle layer of the heart wall (heart muscle)

[5] Rib fractures

[6] Hemothoraces

	Irregularly contoured contusion over right upper chest measuring 10.2 cm (4 in.).	490402.1, 1	922.1	Air bag
	Contusion over medial aspect of left arm measuring 3.2 cm (1.25 in).	790402.1, 2	923	Air bag
	Contusion over inferior right knee as well as anterior right leg measuring 1.9 cm (.75 in).	890402.1, 1 890402.1, 1	924.11 924.10	Lower instrument panel

Other Vehicle Mitsubishi

	INJURY	
Driver:	Back and neck pain	Not codeable

3rd Vehicle Nissan

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Unknown neck and back injuries	390099.1, 9 690099.1, 9	847.0 847.1	Impact forces
Front right occupant:	Unknown neck and back injuries	390099.1, 9 690099.1, 9	847.0 847.1	Impact forces
2nd seat left occupant:	Unknown neck and back injuries	390099.1, 9 690099.1, 9	847.0 847.1	Impact forces
2nd seat right occupant:	Unknown neck and back injuries	390099.1, 9 690099.1, 9	847.0 847.1	Impact forces

Occupant Kinematics

The case vehicle was traveling westbound. The driver of the case vehicle was fully conscious, seated upright on a cloth covered bucket seat, and was wearing the available lap and shoulder belts prior to the crash. She was seated in close proximity to the steering wheel hub, the seat was adjusted to the middle track seat position and the seat back was slightly reclined. The sun glare played a role in the crash as did the driver's BAC of 0.223. It appears that the driver did not see the red signal or the stopped vehicles directly in front of her. There was no pre-impact braking. As the case vehicle struck the back of the Mitsubishi, the driver of the case vehicle moved forward. Her chest was contacted by the deploying driver's air bag as did her face as noted by the lipstick transfer in the upper left quadrant of the driver's air bag. The air bag also contacted her chin and the anterior part of her neck. The fatal injury (the laceration of the right ventricle of the heart near the apex, which led to a cardiac tamponade--anamnestic) appear to be along the seat belt line as a result of loading the 3-point seat belt. Engineers at NHTSA reviewing this report have indicated that analytical modeling of thoracic trauma in frontal impacts have yielded loading patterns on the chest that indicate that 3-point seat belted occupants receive concentrated loading from the seat belt. The laceration of the right ventricle of the heart are being attributed to the loading of seat belt given the location of the injury with respect to the seat belt, the driver's medical condition, her age, and the crash conditions. It is not known wether the fractured ribs where as a result of the crash forces or medical therapy. The driver continued moving forward and struck the lower instrument panel with both of her legs. There was no evidence that the driver contacted the module covers and the steering column was not displaced, there was no measurable displacement of the shear capsules.